Porcine Epidemic Diarrhoea (PED): An Emerging Digestive Pathology

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INTRODUCTION

- PED is not an emerging disease.
- The disease was first seen in 1971 in the UK and resembles TGE
- In February 1971 my experimental pigs developed a TGE-negative diarrhoea and fringed virus particles were seen by EM.
- They were later identified as PED, but no coronavirus electron micrographs existed at that time

- The virus was first described in Belgium in 1978, named CV777, and shown to cause disease experimentally in 1980
- Clinical disease and even outbreaks have continued to occur in Europe since that time

NOVEL VARIANTS OF THE VIRUS HAVE EMERGED

- European isolates have remained antigenically similar since 1978
- PED CV777 has been identified in Asia where vaccines could aid protection
- New variants were identified in China
- One of these has spread to the Americas

THE OLD DISEASE – CLINICAL

- Incubation period 1-3 days
- Can affect non-immune pigs of all ages
- Profuse watery diarrhoea, vomiting in some outbreaks
- High mortality (100%) in piglets aged 0-7 days, declining until weaning
- 20-80% weaned pigs affected
- Lasts for 3-8 days

PORCINE EPIDEMIC DIARRHOEA SUCKING PIGS, 1977

GROWING PIGS 1996

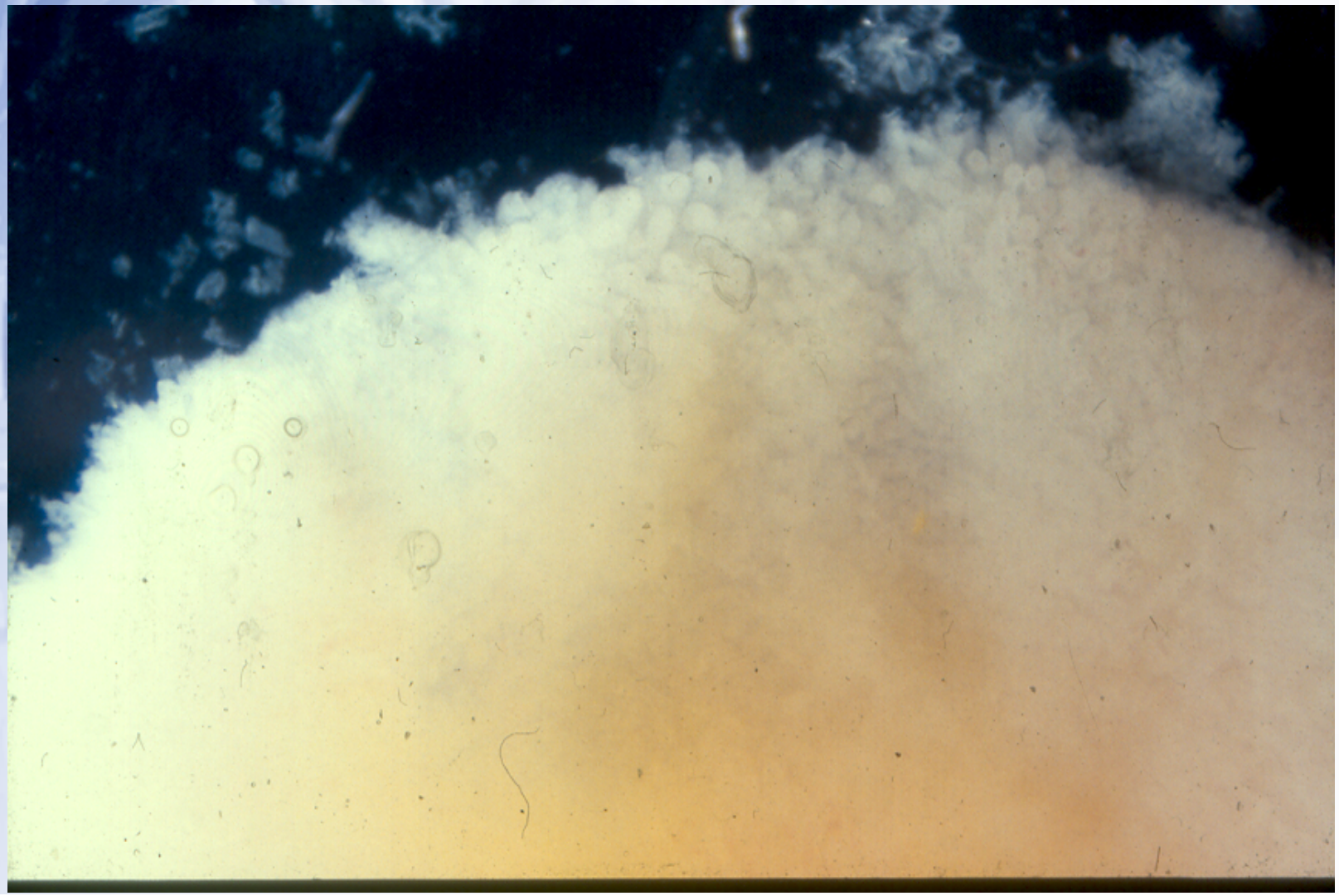
THE OLD DISEASE – PATHOLOGICAL

- Dehydrated carcases
- Villous atrophy in small intestine
- Fluid intestinal contents
- Gastritis in piglets where vomiting has occurred
- Virus in small intestinal villous tips
- Other agents present in chronic disease

SMALL INTESTINE - PIGLET PED

OPENED GUT – PIGLET PED

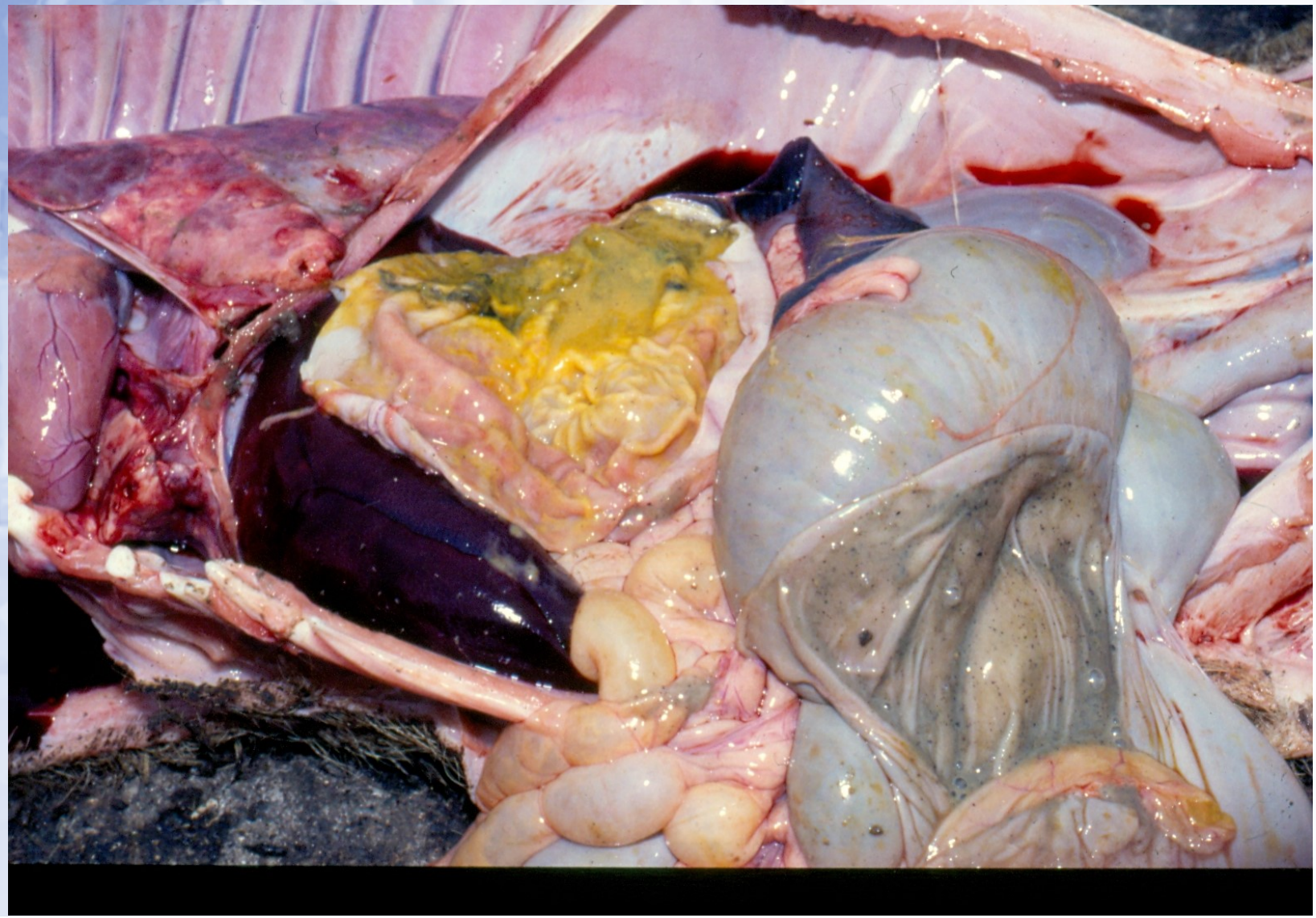
VILLI FROM NEONATAL PIG JEUNUM PED



NORMAL NEONATAL PIGLET VILLI

DEAD GROWER

GROWER POST MORTEM



THE OLD DISEASE - DIAGNOSIS

- Clinical signs and gross pathology difficult to differentiate from TGE
- Initial diagnosis based on weaned pigs only, then piglets only and elimination of TGE
- Serological tests and viral isolation
- Finally RT-PCR

DISEASE SPREAD AND BIOSECURITY

- The Americas and Australasia had never had PED
- In Europe there is immunity in some herds to classic PED (5%, UK, 2014)
- Entry of novel PED viruses to Europe will find up to 95% herds susceptible
- Current practices appear not to encourage spread

CRITICAL FEATURES IN BIOSECURITY

- Properties of the virus
- Known mechanisms of spread between animals
- Mechanisms of spread within farms
- Spread between farms
- Entry to countries/continents

PROPERTIES OF THE VIRUS

- Alphacoronavirus (Delta coronavirus recently recognised)
- RNA
- Spike protein important in pathogenesis
- All old strains antigenically similar
- Destroyed at >60°C (30 minutes), but is stable at 50°C
- Stable at 37°C at pH 6.5-7.5 and at 4°C between pH5.0-9.0
- Survives freezing

THE VIRUS AND THE PIG

- Levels of virus production by an infected animal are high (millions of particles per mL)
- Large amounts of liquid faeces produced
- Faecal contamination throughout a building
- Systemic immunity does not prevent carriage

SPREAD BETWEEN ANIMALS

- Infection is faecal/oral
- Piglet to piglet
- Sow to piglet
- Weaned pig to weaned pig
- Via feed or water contaminated with virus ultimately from faeces
- Via items contaminated with faeces

SPREAD WITHIN FARMS

- Movement of infected animals
- Within buildings
- From building to building
- From pen to pen in open or half open systems
- Indirectly by aerosols, people, tools, feed, water, semen, rodents and birds

SPREAD BETWEEN FARMS

- Movement of carrier pigs. Carriage for up to 56 days has been reported
- Contaminated fomites – clothing, vehicles, feed, equipment
- Aerosol spread is possible (demonstrated 2014 to 15km)
- Birds such as starlings
- Spread is more likely in cold weather

STARLINGS ON FARMS

BIRD DROPPINGS

OUTDOOR PIGS

ENTRY TO COUNTRIES/CONTINENTS

- Movement of carrier pigs
- Fomites – clothing
- Contaminated feed (spray dried plasma, Canada)
- Semen and embryos
- Migrating birds?

FACTORS IN THE SPREAD OF PED OLD VERSUS NEW

- PED (CV777) present in Europe and Asia
- Some herds antibody to CV777 in Europe and Asia (Spain 55% 1995, UK 5% 2014)
- New variant present in China and in US from April 2013
- No herds in US immune
- Field immunity to new variant unknown in Europe (CV777 vaccines do not work in Asia)

FACTORS IN THE SPREAD OF PED OLD VERSUS NEW

- Hygiene variable
- Farm size variable
- Herd size for persistence of infection 20 sows
- Many self-contained farms
- Little AI

- Hygiene variable
- Much larger farms in US than in 1970s Europe (and now in modern Europe)
- Breeding stock moved routinely
- Semen sales routine

FACTORS IN THE SPREAD OF PED OLD VERSUS NEW

- Protein supplements fishmeal, meat and bone meal and some soya
- On farm disposal of carcases
- Lorry washing rare unless Notifiable disease present

- Protein supplements soya and spray dried plasma
- Carcase collection (Europe)
- Lorry washing required (but not always carried out)

FACTORS IN THE SPREAD OF PED OLD VERSUS NEW

- Aerosol spread not proven
- Forced ventilation less common
- Less slurry spreading
- Outdoor pigs present

- Aerosol for up to 15km demonstrated
- Forced ventilation common
- Cooling of pigs in Mexico and US
- Large slurry stores
- Scrubbing exit air (Netherlands)

PREVENTION

- Biosecurity to prevent entry
- Disinfectants
- Personal hygiene
- Management within the infected farm
- Support affected piglets
- Feedback to sows

BIOSECURITY TO PREVENT PED ENTRY TO A COUNTRY/CONTINENT

- Do not import carrier pigs (base criteria on PED history of source country, history of source farm and evidence of negative serology and RT-PCR screening)
- Ensure semen and embryos produced using above criteria
- Only import spray dried porcine plasma which is virus free (clean source, sterilised) if used.
- Ensure feed other feed components cleanly sourced and uncontaminated (Feed Chain Information)

BIOSECURITY TO PREVENT PED ENTRY TO FARMS I

- Isolation of farm
- To reduce aerosol risk:
- Site at least 15km from possible infection
- Use windbreaks to reduce aerosol risk
- Enclosed buildings (bird proof)
- Side fans, not ridge fans
- Ensure that pig slurry from other farms is not being applied locally.

ISOLATION

BIRDPROOF VENTILATION

BIOSECURITY TO PREVENT PED ENTRY TO FARMS II

- Secure perimeter (fence, external concrete access for delivery and collection)
- Internal dedicated vehicles, if required
- Feed blown over fence from lorries at first delivery of day
- Workmen require permit to work and appropriate disinfection of tools and materials

LOADING BAY


ALL LORRY DRIVERS
& VISITORS MUST WEAR
PROTECTIVE FOOTWEAR
PROVIDED BEFORE
PROCEEDING

SECURE PERIMETER FENCE

INTERNAL VEHICLE!

BIOSECURITY TO PREVENT PED ENTRY TO FARMS III

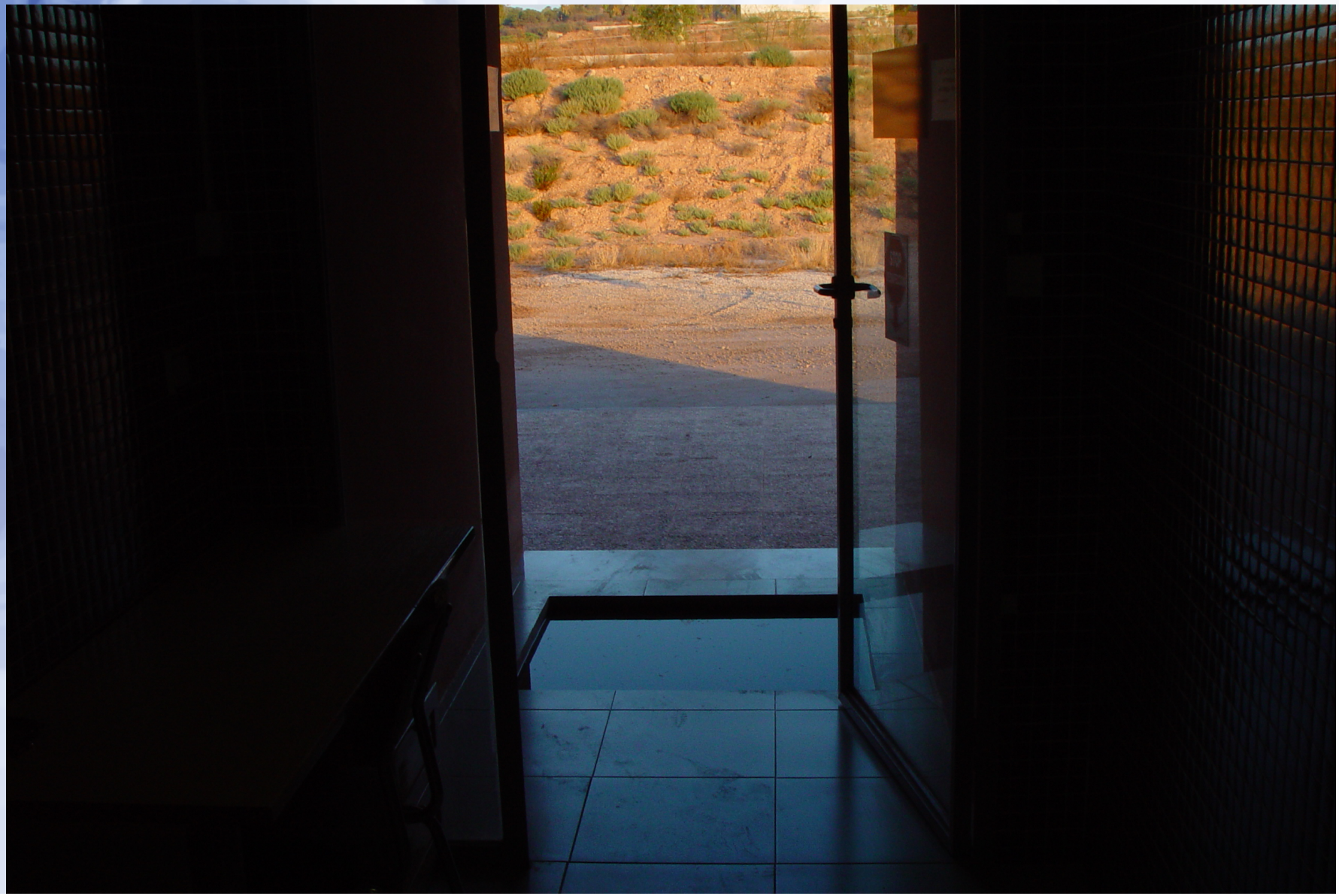
- Do not buy or bring in carrier pigs (base criteria on PED history of source farm and evidence of negative serology and RT-PCR screening)
- Quarantine any brought in pigs in isolation and test if required (RT-PCR)
- Ensure semen and embryos produced using above criteria

BIOSECURITY TO PREVENT PED ENTRY TO FARMS IV

- Ensure staff do not have outside contact with pigs
- Require visitors to be pig clean
- Shower staff and visitors in and out of unit
- Provide clean outer clothes and ensure entry through disinfectant dips (Virkon)

SHOWERS

DISINFECTANT DIP



BIOSECURITY TO PREVENT PED ENTRY TO FARMS V

- Source feed ingredients free from contamination (Feed Chain Information)
- Do not use spray dried porcine plasma proteins
- If they must be used, source from PED free countries or ensure that heat treated for freedom from virus

BIOSECURITY TO PREVENT PED ENTRY TO FARMS VI

- Outdoor farms or those with outdoor access are at particular risk of PED
- Aerosol and bird access cannot be prevented.
- Ensure that staff are aware of the disease and provide hygiene, disinfectants and dedicated tools and vehicles
- Have contingency plans for housed stock on the farm should PED occur

BIOSECURITY ON A PED INFECTED FARM

- Management of the disease may mean isolating sows about to farrow until immune sows reach farrowing.
- Buildings or areas may need to be cleaned and disinfected (VIRKON)
- Rodents should be controlled
- Change clothing and boots on entry, disinfect and use dedicated implements
- Wash hands before and after working

FEEDBACK AND ITS RISKS

- Feedback may be the only available method of control and must be agreed with Competent Authority
- UK advice is to use faeces or intestinal content only, NO TISSUE.
- Only early cases should be used
- Infectious material can be stored frozen
- Sows exposed at least 3-4 weeks prior to farrowing
- Other agents may be present

BIOSECURITY TO PREVENT ONWARD SPREAD OF PED I

- Shower and use street clothes after leaving farm
- Do not visit other pig farms
- Move pigs only to slaughter using routes which avoid other pig farms
- Do not sell semen or embryos
- Ensure carcases and waste collected safely

BIOSECURITY TO PREVENT ONWARD SPREAD OF PED II

- Provide washing/disinfection facilities for visiting vehicles which should remain outside the farm
- Net buildings against birds to prevent onward spread
- Manage pig movements to reduce aerosols
- Hold slurry for 6 months and then inject, not spray

CONCLUSIONS

- PED has been present in Europe for 40 years
- The introduction of novel viruses might result in severe outbreaks of disease
- Biosecurity at Continental and National level may keep it out
- Biosecurity on farms may prevent entry of the disease and its onward spread from infected farms
- Aerosol infection may be difficult to prevent
- Outdoor pigs are at particular risk

AT RISK OF PED!